TO: Jim.Zolnierek@illinois.gov, Torsten.Clausen@illinois.gov

Mr. Zolnierek and Mr. Clausen:

Thank you for the opportunity to submit comments to the ICC Energy Storage Program Workshop. Armada Power runs thermal storage programs with private companies, utilities, and cooperatives. Armada's programs are grid connected thermal storage using water heaters for millisecond shifts in response to the grid. We hope the attached information will aid the ICC in its evaluation of all types of storage options to achieve Illinois' climate goals.

Energy storage in general acts as both generation and consumption, however innovative technologies are changing how we view storage. It is no longer a traditional battery. Thermal storage is a solution to use and store energy in response to grid conditions using behind the meter resources such as pre-heating with solar, aggregated water heaters with millisecond control (like Armada) or cooling technology these in combination with traditional batteries expand energy storage beyond batteries. In fact, combining programs improve the life of traditional battery storage by reducing quick discharge life erosion.

When measuring the potential costs and benefits of energy storage deployment it is critical that the ICC not view the benefits through the tunnel of a single project and a single use. Deployment of storage when viewed in aggregate improves the costs and benefits of projects across the grid.

Respectfully Submitted,

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I. Discussion

The future of the electrical grid and effective utilization of renewable generated electricity requires not just storage to grid dispatch capabilities but thermal storage and storage control to shift kWh and demand to in response to the grid. As beneficial electrification along with carbon free supply provide a solution to meet Illinois' goals this approach comes with an increase in energy use – even when efficient appliances are used the addition of a fuel switched load still results in additional kWh use. This in turn will lead to peaky demand which results in traditional battery storage also needing to address fast dispatch requirements which in turn can create costs through eroded life of batteries. To manage this increased strain on the electric grid, it is imperative that Illinois plan for technologies which can absorb those quick dispatch needs at not only a lower cost but potentially bring other benefits and cost reductions. This need to shift load in response to the grid and not solely dispatch stored power must be a measurement of cost benefits to storage programs. In addition, to achieve consumer adoption and avoid rate shock it is important that Illinois look for technologies which allow for the greatest number of uses+benefits in conjunction with other projects and measure those costs + benefits across projects. To do this Illinois should include in its analysis the benefits and costs of energy storage technology programs that are both direct and consumer controlled, achieve fuel shifting and benefit the grid through fast discharge and provide fast response for renewable firming.

The critical control function must be fast response with limited to no recovery time to ensure alignment as an energy storage technology to achieve not only demand needs of the grid but also renewable production. By incorporating a program to use passive appliances like electric resistance water heaters which make up a sizable portion of residential load[1] during the time which renewable electricity is being generated ensures that energy will not be wasted, decreases quick dispatch strain on traditional battery storage, and maintains the reliability of the grid.

[1] https://www.energy.gov/energysaver/heat-and-cool/water-heating

For example, fast discharge electric resistance water heater control technology increases beneficial impacts to the electrical grid at a rate 5x higher than a thermostat program alone[2]. Achieving energy storage in a manner like a battery.

Electric resistance water heaters can function as thermal storage devices while maintaining a comfortable temperature for hours. Electric resistance water heaters in an energy storage program are less likely to be opted out of because there is no impact to a customer's comfort level, making electric resistance water heaters a reliable option for quick discharge.

Technologies aggregated and connected have a greater impact on the existing infrastructure by absorbing and firming renewable production in real time, shifting demand from the grid in aggregate, absorbing quick discharge needs to extend the life of traditional batteries. Further, connected non-invasive large appliances like water heaters can come back on to the grid slowly to not create a new peak event, enhancing the reliability of the existing grid and storing energy to support distribution grid functionality such as cold load pickup, circuit level control and droop control. When measuring the costs and benefits of storage the savings across a value stack of demand control, cold load pickup, droop control, circuit control, carbon reduction, renewables firming as well as other grid resiliency attributes must be measured – not simply the amount of energy stored and then pushed out.

II. Thermal Storage Does Not Require a Significant Investment and is Affordable

Electric resistance water heaters can be affordable and inclusive, as electric resistance water heaters are typically less than $500 dollars[3], and a device retrofit to transform the electric resistance water heater into a smart, grid-connected device at an affordable price as well. Incorporating these technologies also allows for lower costs and likely higher adoption because

[2] A 40-gallon water heater, with a 10-degree Fahrenheit fluctuation requires 0.95kWh to heat the water back up to 130 degrees Fahrenheit from 120 degrees Fahrenheit. One smart electric resistance water heater can shift approximately one kilowatt-hour of electricity to use and store renewable generated electricity and shift usage to manage the grid. A thermostat program which adjusts the temperature of a 2600 square foot home by 5 degrees would require about 5 homes to have the same grid impact as that of an electric resistance water heater.

[3] https://www.houselogic.com/organize-maintain/home-maintenance-tips/hot-water-heater-buyers-guide/

residents do not need to replace existing appliances with significantly more expensive versions. In instances where electric resistance water heaters are already installed the addition of an electric resistance water heater controller like Armada in fact expands the use of that appliance for these purposes immediately.

III. Measurement of Equity and Inclusion for All Consumers

Grid connected electric resistance water heater programs benefit low-income customers through well designed demand response and time of use pricing with minimal investment from a customer. Gas water heaters should be replaced with electric resistance water heaters at a lower cost, while existing appliances can be retrofitted, rather than replaced, to be transformed into a smart, and demand responsive thermal storage device. Not only will residential customers be able to leverage their water heater into a thermal storage device, but they will be able to save money on carbon focused fuel switching and potentially earn money from demand response programs. The benefits accrue even further to multifamily properties where tenant and home renters will not need to invest or install new technologies in a home they do not own, but they will be able to receive the benefits of these technologies. A multifamily specific component will ensure easy and broad deployment of the thermal storage in turn reducing costs to deploy and allowing participation by customers who do not own their home and may not have access to traditional energy storage technologies. Multifamily also offers a single appointment for multiple installs which also reduces costs in terms of time installation techs. A thermal storage program with water heater technologies for all customers, will provide to traditionally neglected rental communities the opportunity to benefit from utility programs.

IV. Measure Sustainability of the Communities

Sustainability does not just mean renewable generation it also means grid stability, and storage additions to the grid must support and improve the reliability of the electric grid. Some methods to improve grid reliability and enhance sustainability would be through cold load pick up, local voltage support, and primary droop control. Storage technology which helps to reduce restoration times after sustained outages by removing the power draw of certain appliances from

the initial cold load pickup are one example of how storage can aid in grid reliability. This allows circuits to be re-energized faster with less risk of tripping out upstream protection. Technology which also can respond to local voltage deviations from distributed renewables and provide revenue quality measurements to augment other distribution automation systems are another option. A connected fleet of devices similar to a battery can respond with a greater magnitude with larger changes in frequency or with a smaller magnitude and slower with small changes in frequency simulating the governor control on a generator. Storage technologies which allow devices to respond to locally measured deviations in system frequency within a few cycles to get benefits beyond simple supply or demand response and achieve a sustainable stable grid.

Quick discharge grid connected thermal storage appliances, can rapidly respond to the grid needs and absorb clean energy. In turn, charging and discharging does not wear out electric resistance water heaters, while mitigating the need to call to grid batteries[4]. Quick discharge thermal storage will improve the stability of the grid and extend the life of grid batteries, furthering sustainability goals.

V. Conclusion

When valuing the costs and benefits of energy storage the ICC should incorporate all forms of energy storage and value their impact in aggregate. Incorporating multiple storage solutions to address erosion of battery life due to quick dispatch improves the costs for traditional battery storage projects. In addition, measuring impacts of thermal storage through their grid and resiliency impacts improve the cost benefit value stack for residential solutions beyond traditional demand response. Storage must be measured and valued across the grid and incorporate more than traditional battery storage to achieve the greatest benefits. Grid Connected Water heaters will further decarbonize buildings by charging during periods when renewable energy is being generated. Further, smart devices with millisecond response time will assist in activating the local energy ecosystem with the ability to respond when local wind and solar are being generated. As a connected device, a fast-responding controlled water heater will optimize the existing

[4] Life prediction model of Battery Storage: https://www.nrel.gov/docs/fy17osti/67102.pdf

infrastructure by acting as a quick discharge thermal storage device and reducing the load on the grid during peak times. The commission should measure the potential costs and benefits with a broad range of technology.